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ABSTRACT

A study investigated Japanese 3-to-5-year-olds' comprehension of sentences using the temporal terms "before" and "after" and examined whether contextual information helped the children respond correctly. The children were asked to perform a task with a toy either before or after performing another task with a different toy. Some children were provided with a choice of toy for the task (context) and others were not (no context). Results indicate that by five years, Japanese children know the meaning of temporal terms, a finding similar to that for English-speaking children. The results on contextual support suggest that contextual information was helpful in a methodological way, when the order of suggestion of the tasks matched the order of their supposed performance. This finding favors a processing rather than syntactic or semantic account of children's performance failures. (MSE)

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Comprehension of Temporal Sentences by Japanese Children

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1. Introduction[1]

It has been reported that children comprehend sentences with temporal terms like "before" and "after" more easily when the order of mention matches the order of occurrence (E. Clark 1971). For example, sentences like (1) and (2) are comprehended more easily than sentences like (3) and (4).

(1) John jumped the gate before he patted the dog.
(Event 1 before Event 2)
(2) After John jumped the gate, he patted the dog.
(After Event 1, Event 2)
(3) Before John patted the dog, he jumped the gate.
(Before Event 2, Event 1)
(4) John patted the dog after he jumped the gate.
(Event 2 after Event 1)

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Sentences (1) - (4) depict the same event. Since the order of main and subordinate clauses can be changed in English, the choice of the clausal order seems to bring different processing demands. Sentences (1) and (2) match the order of occurrence. In Clark's act-out task, sentences like (1) and (2) evoked more correct responses than (3) and (4). This is called an order of mention strategy. Clark also finds that "before" (1) evokes more correct responses than "after" (2). This is interpreted as evidence that "before" is acquired earlier than "after". With this interpretation, E. Clark (1973) proposes a "Semantic Feature Hypothesis" (henceforth SFH). The SFH suggests that when children acquire the meanings of words, what they do is to fix values of the semantic features of the term in question. For instance, temporal terms have [+Time], [+/-Simultaneous], and [+/-Prior] (e.g., "before" = [+Time, -Simultaneous, +Prior] and "after" = [+Time, -Simultaneous, -Prior]). Since it is interpreted that "before" is acquired earlier than "after", Clark suggests that the default value of [+/- Prior] is [+Prior]. Therefore, once children set up values like [+Time, -Simultaneous], automatically [+Prior] is obtained. Similarly, to explain E. Clark's data and its interpretation, H. Clark (1973) proposes a "Complexity Hypothesis" (henceforth CH), which predicts that words with a "positive" semantic concept will be acquired earlier than those with a "negative" concept. The concept of "positive/negative" for temporal terms was advanced from spatial relationships and it is considered to be correlated with perceptual space. Therefore, the spatial term "before" is positive because the space indicated by this term is easily perceptible while "after" is negative because everything behind is not easily perceptible. Since "before" is positive in the "before/after" pair, the CH predicts the early acquisition of "before". Therefore, by hypothesis, "before" is acquired early and sentences with "before" should be better comprehended than sentences with "after".[2] Since these hypotheses are based on semantics, (particularly, the CH is formulated based on perceptual space, which is a human universal), they are considered to be universal. That is, they predict that BEFORE is acquired earlier than AFTER in any language. Therefore, better comprehension for BEFORE should be found in comprehension tests from any language.

Gorrell, Crain and Fodor (1986), however, found that there is not much difference between "before" and "after" in a test with English-speaking children, which can be interpreted as evidence for the view that children acquire the meanings of "before" and "after" together, contrary to the SFH and the CH. Also they found that there is no significant difference in accuracy for sentences in which the order of mention mirrors or contradicts the order of occurrence; but rather they found that contextual information significantly played an important role in obtaining correct responses from children. In their study, the verbs of the main and subordinate clauses were the same. Therefore, their act-out task would have been much simpler than the

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[1] We would like to thank Diane Lillo-Martin and Stephen Crain for their helpful discussions and comments.

[2] In Clark (1971), "after" evoked more correct comprehension than "before" when the order of mention doesn't match the order of occurrence. That is, (4) was easier than (3). If the difficulty of processing in sentences (3) and (4) were the same, the CH should predict that (3) is easier than (4), which apparently contradicts the data.

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task in E. Clark's study. [3] Contextual information was supplied in Gorrell, Crain, and Fodor's study by asking children to pick out a toy or toys to play with. The experimenter would then use the toy which the child chose in the subordinate clause; using this technique, more correct responses were evoked (but when no toys were chosen, accuracy went down). This is because by choosing a toy or toys to play with in advance, the child can expect them to be used in what he does in response to the experimenter's sentences. That is, his planning is partially fulfilled with the object or objects he deals with and therefore, the planning of his entire act would be easier to be formulated. Hence, contextual information can help children's performance. If contextual information is important in the methodology as Gorrell, Crain, and Fodor discuss, we would expect that similar results would be found in other languages. That is to say, more correct responses would be evoked in the subject group which is given sentence tokens with contextual information than in the group without contextual information in the given language.

The present paper investigates whether there are differences with respect to order of mention or contextual information among sentences with different temporal terms in Japanese. In this language, unlike English, the clausal ordering is fixed in basic word order (subordinate clauses may not follow the main predicate). Therefore, we cannot compare order of mention strategy within the same temporal term, although we may find differences in performance among the three temporal terms. Such differences may be due to a processing demand which would not be found in English, simply because English is a head-first language while Japanese is a head-final language. Further, if we can find performance differences in the subject groups with and without contextual information, the finding would indicate an important factor in methodology used universally.

2. Temporal terms in Japanese

There are three temporal terms in Japanese, "maeni (BEFORE)", "atode (AFTER)", and "kara (AFTER)".[4] All of these terms are post-clausal since Japanese is a head-final, left-branching language. Consider the examples below.

(5) John-ga neru maeni, ha-o migaita.
Nom sleep before teeth-Acc brushed
"Before John slept, he brushed his teeth."

(6) John-ga ha-o migaita atode, neta.
teeth-Acc brushed after slept
"After John brushed his teeth, he slept."

(7) John-ga ha-o migaite kara, neta.
after slept
"After having brushed his teeth, John slept."

Sentences (5)-(7) depict the same event. Although the three temporal terms are post-clausal elements, their syntactic uses are different, as illustrated in the examples above. The term "maeni" (BEFORE) doesn't take a past tense (or perfectual) verbal morpheme ("ta") preceding it. It only takes a non-past tense form (present or no-tense). Therefore, (8) is ungrammatical. Tense in the subordinate clause depends on the tense in the main clause. Only main verbs are inflected.

(8) *John-ga neta maeni, ha-o migaita.
slept before teeth brushed
"Before John slept, he brushed his teeth."

On the other hand, the term "atode" (AFTER) doesn't take a non-past tense (or present) verbal morpheme ("-u") preceding it. Therefore, (9) is ill-formed.

(9) *John-ga ha-o migaku atode, neta.
teeth brush after slept
"After John brushed his teeth, he slept."

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[3] Note that the act-out task used in Clark's study presumably requires more complicated planning than that of Gorrell, Crain and Fodor. Therefore, it is plausible to consider that the complication of planning masked performance in Clark's study. Then, the data in Clark's study may not have revealed real grammatical knowledge in her children. See Hamburger and Crain (1984) and Hamburger and Crain (1987) for discussions on planning.

[4] When temporal terms take NPs as their arguments, there are only two postpositions, "maeni" and "atode".

One term "kara" (AFTER) requires a different syntactic structure from the other two temporal terms ("maeni" and "atode"). "Kara" takes the "-te" verbal form, which is similar to the "-ing" in English. This "-te" form is often used in other constructions in Japanese.[5]

It is important to note that the three types of sentences can have different subjects in their main and subordinate clauses, as illustrated below.

(10) John-ga koko-ni kuru maeni, Mary-ga koko-ni kita.
Nom here-to come before Nom here-to came
"Before John came here, Mary came here."

(11) John-ga koko-ni kita atode, Mary-ga koko-ni kita.
Nom here-to came after Nom here-to came
"After John came here, Mary came here."

(12) John-ga koko-ni kite kara, Mary-ga koko-ni kita.
here-to coming after here-to came
"After John came here, Mary came here."

Since Japanese allows empty NPs, the NP which is coindexed with "John" is not pronounced in either the main or the subordinate clause in (5)-(7). It is not evident if the empty NP is in the main clause or in the subordinate clause because it can't be realized phonetically. So, for example, two representations are possible for (5).

(5)a. [John-ga$_i$[[e]$_i$ neru maeni] ha-o migaita]

b. [[John-ga$_i$ neru maeni]$_j$ [[e]$_i$ [t]$_j$ ha-o migaita]]

(5a) involves no movement while in (5b) the temporal clause was scrambled, adjoining to S. (See discussion on scrambling in Saito 1985.) We ignore the differences in representation in this paper because they are irrelevant for the present discussion.

3. Experiment

In order to find out if young Japanese children comprehend sentences with these three temporal terms differently, an experiment was designed and given to 24 3-to 5-year old Japanese children. This experiment was also intended to find out if contextual information helps children to respond correctly.[6]

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[5] The frequency of the use of this "-te" form seems rather high. This may contribute to the children's early mastery of the "-te" form as discussed in Clansy (1985).

[6] The present study cannot examine the CH because of the fixed clausal order. However, it may be possible to investigate if the CH would hold in Japanese when dislocation sentences like (ii) are used in contrast with (iii).

(i) John-ga neru maeni, ha-o migaita.
sleep before teeth brushed

'John brushed his teeth before he slept.'

(ii) John-ga ha-o migaita, neru maeni.
teeth brushed sleep before

'John brushed his teeth before he slept.'

(iii) John-ga ha-o migaita atode neta. (= (6) in the main text)
after slept

'After John brushed his teeth, he slept.'

(ii) is a case of left-dislocation (see discussion on left-dislocation in Haraguchi 1974). Although by using dislocation forms it is possible to have pairs parallel to the English examples, we aren't sure if the dislocation form doesn't become a factor for impeding children's performance since it is reported that young children are hesitant to use dislocations (Lust and Wakayama 1978). It may well be helpful to use simple sentences like (iv)-(vii) to examine the CH and the relevant factors in the present discussion. Since temporal terms are used as postpositions, overall processing demands should be reduced.

Design and Procedure

The task employed in this experiment was a "pushing game", the same as in Crain (1982) and Gorrell, Crain, and Fodor (1986). The task required children to act out what they were asked to do (based on their comprehension) (here, to push some toy). For instance, the experimenter asked: "Before you push the car, push the helicopter." Then, the subject would act this sequence out based on his comprehension. If he pushes the helicopter before he pushes the car for the above request, it is counted as correct. If he reverses the two events, doesn't complete the two events, or pushes the wrong objects, it is counted as incorrect.

The experimental subjects were divided into two groups (Context vs. No Context). The task was the same for all subjects in the two groups. However, for the Context Group, the plan of the subordinate clause was satisfied by having the child choose a toy to play with next. The subjects in the Context Group chose the item which they wanted to push before the experimenter asked them to do so. So if the subject would choose the car, the experimenter asked him, "Before you push the car, push the helicopter". On the other hand, the subjects in the No Context Group weren't asked to choose any toys to play with. All of the information for performing the task was supplied only by the experimenter. If contextual information helps children's performance, the Context Group is expected to evoke more correct responses than the No Context Group.

The order of presentation for the three temporal terms was varied in three ways in order to counterbalance and to find out if there is any difference based on the order of presentation. Each presentation contained 9 trials for each child (i.e., three for each of the three temporal terms).

The entire experiment was conducted in Japanese by a native speaker of Japanese. Before starting the test sentences, children were asked to identify the toys in the workspace as a pretest. Then, they moved on to the test session. An example asked by the experimenter follows.

(13) Kuruma-o osu maeni, densha-o oshite choodai.
car-Acc push before train-acc push please
"Before you push the car, push the train."

Subjects

Twenty-four Japanese children from 3;2 to 5;10 (mean = 4;4) participated in the experiment. The subjects were randomly assigned to two groups (Context vs. No Context) of equal size, matched for the mean age. The mean ages of both Context and No Context were 4;4. All children were at Takiooji Hoikuen (Takiooji Day-care Center) in Shinagawa Ward, Tokyo, when the experiment was conducted.

Results and discussion

None of the children failed to identify the toys in the workspace. Therefore, every child moved on to the test session. A total of 216 responses were obtained from these 24 children. Of 216 trials, children made 165 correct responses (76%) over all. None of children made incorrect responses for all trials. Each child made at least 4 correct responses. The overall ratio of correct responses to incorrect responses shows that the task wasn't too difficult even for the younger children of this age group, and that at least they have some sort of idea about temporal clauses. Figure 1 below gives the frequency and percentage of overall correct

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(iv) Gohan no maeni John-ga te-o aratta.
meal before Nom hand acc washed

'Before the meal, John washed his hands.'

(v) Gohan no atode John-ga ha-o migaita.
meal after Nom teeth acc brushed

'After the meal, John brushed his teeth.'

(vi) John-ga te-o aratta, gohan no maeni. (dislocation)

'John washed his hands before the meal.'

(vii) John-ga ha-o migaita, gohan no atode. (dislocation)

'John brushed his teeth after the meal.'

responses by group and term. Since differences in the order of the presentation don't reach significance ($F(2, 23) = 0.04$, $p < .9567$), it is disregarded in Figure 1 below.

	Kara(AFTER)	Atode(AFTER)	Maeni(BEFORE)	Total
Context	34 (94%)	31 (86%)	20 (56%)	85 (79%)
No Context	32 (89%)	26 (72%)	22 (61%)	80 (74%)
Total	66 (92%)	57 (79%)	42 (58%)	165 (76%)

The Context Group consists of 12 children who were supplied contextual information, while the other 12 children in the No Context Group had no context supplied. Except "maeni" (BEFORE), the Context Group showed more correct responses than the No Context Group. Though overall performance by the Context Group was slightly better than the No Context Group, the difference is not significant ($F(1,23) = 0.37$, $p < .5509$). It is important to point out that the Context Group did worse for "maeni" (BEFORE). This suggests the contextual information hurt the expectations of the subjects. Recall that the contextual information is for the subordinate clause and the subordinate precedes the main clause. Further, the temporal terms follow the subordinate clause in Japanese. Therefore, in the case of BEFORE with contextual information, children expect to play with the toy they chose and they hear the name of the toy, but right after they hear it, they find out that BEFORE is used. Hence, they have to hold in memory the first act with the chosen toy. In this fashion, their expectation is broken down and an additional processing demand is required. Therefore, their performance for BEFORE is slightly worse than AFTER. This finding was not observed in English, simply because English is a head-first language and "before" comes at the clause initial position. Thereby, children can process the temporal term before the event depicted by the following clause is understood. This finding suggests that contextual information is helpful in a methodological way for the young children whose language is head-first.

Among the three temporal terms, "kara"(AFTER) evoked the most correct responses and "maeni"(BEFORE) evoked the least in both groups. This difference is statistically significant ($F(2,23) = 4.99$, $p < .0112$). This seems to suggest that the finding of Clark (1971) holds in Japanese. That is, children comprehend sentences more easily when order of mention matches order of occurrence. This is also seen in the fact that no child made errors for all of "kara"s (AFTER), though for "maeni" (BEFORE) eight children responded all incorrect.

Figure 2 shows the breakdown of terms by two age groups (younger group = 3;2-4;4, older group = 4;4-5;10). (Since contextual information isn't significant, the two groups are collapsed.)

	Kara(AFTER)	Atode(AFTER)	Maeni(BEFORE)	Total
Younger	31(86%)	26(72%)	17(47%)	74(69%)
Older	35(97%)	31(86%)	25(69%)	91(84%)
Total	66(92%)	57(79%)	42(58%)	165(76%)

As shown in Figure 2, the older children performed better on each term. The difference by age group is statistically significant ($F(1,23) = 5.69$, $p < .0261$). Even for the younger group, "kara" (AFTER) gives the best performance, perhaps because "te" forms are frequently used. Since "kara" seems to be more often used, this would decrease the frequency for "atode" (AFTER), which results in lower comprehension. However, since these AFTERs don't cause an additional processing demand, even "atode" is better than "maeni" (BEFORE). If the processing account is correct, when children fix their parameter for word order (head first/final) and have a basic syntactic structure in their languages, the ease of the comprehension for temporal terms will be predicted. That is to say, BEFORE is easier than AFTER in head-first languages when the temporal clause follows the predicate phrase of the main clause, while in head-final languages, AFTER is easier than BEFORE when the temporal clause precedes the main predicate.

Next, let us look at the errors children made. Figure 3 shows the errors that appeared in the experiment.

	Kara(AFTER)	Atode(AFTER)	Maeni(BEFORE)	Total
Sub. only	2	3	7	12 (24%)
Main only	0	2	2	4 (8%)
Reversal	4	10	20	34 (67%)
Others	0	0	1	1 (2%)
Total	6 (12%)	15 (29%)	30 (59%)	51 (100%)

Of a total of 51 errors, none were due to the child's choosing the wrong objects. Thirty-three errors were made by 11 children who acted out incorrectly three times for the term in question, though errors are not necessarily of the same type for each term. Of 11 children, 3 made consistent errors for "atode" and 8 did so for "maeni". This error distribution by the children who made consistent errors also suggests a different comprehension by item. In error types, 16 of 51 incorrect responses are due to children's failing to complete the act (preforming either the subordinate clause only or the main clause only). Since the subordinate clause comes first with temporal terms in Japanese, if the child only acts out what he hears first, this will result in an error of acting out the subordinate clause only (indicated by 'Sub only' on Figure 3), which explains 12 of 16 incomplete acts.

More than half of the errors (67%) are reversal acts (i.e., children acted out the reversed sequence). For instance, when the subordinate clause contains BEFORE, they acted out the subordinate clause first and then, the main clause, which resulted in the reversed order of action. "Maeni" evoked the most errors among the three terms. Of 20 errors of "maeni", 18 are due to consistent errors made by 4 younger and 2 older children. Of 10 errors of "atode", on the other hand, the consistent errors were made only by a younger child. It is important here to note that these children who consistently made errors for one term didn't make any errors for the others at all. This seems to suggest that six children who made errors for "maeni" consistently adopted some sort of strategy or misassigned the meaning of "after" to "maeni". (If this is correct, it may suggest that the hypothesis that the notions of "before" and "after" are acquired simultaneously is not warranted (because those children are assigning the meaning of "after" to all of the three terms).) At any event, children are trying to figure out the lexical meaning of the third temporal term.

4. Conclusion

The present study examined the order of mention strategy and the importance of context in Japanese sentences with temporal terms (one BEFORE and two AFTER). It was found that by 5, children know the meaning of temporal terms, similar to the finding reported for English speaking children by Crain (1982). Performance by the group with contextual support was slightly better than the group without context, though the difference was not significant. The results on contextual support suggest that contextual information was helpful in a methodological way, particularly for a language whose head is first. The main finding was that the temporal term "kara" (AFTER) evoked the most correct responses and "maeni" (BEFORE) evoked the fewest in both groups. This suggests that children comprehend sentences more easily when the order of mention matches the order of occurrence, an interpretation that favors a processing account rather than a syntactic or semantic account of children's performance failures.

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Comprehension of Temporal Sentences by Japanese Children

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The present study examines the order of mention strategy and the importance of context in Japanese sentences with temporal terms (one BEFORE and two AFTER). The task in this study was a "pushing game". Nine requests (three for each term) like (1) were given to twenty-four 3-to 5-year-old children (mean age = 4;4). Subjects were randomly assigned to two groups (context vs. no context) of equal size, matched for age. The context condition satisfied the presupposition associated with the subordinate clause. For instance, (1) was uttered when the child chose a car to play with.

(1) Kuruma-o osu maeni, densha-o oshite choodai.
car-Acc push before train-acc push please
"Before you push the car, push the train."

Out of a total of 216 responses, 165 were correct (76%). None of the children consistently made incorrect responses and each child made at least 4 correct responses, suggesting that by 5, children know the meaning of temporal terms. Performance by the group with contextual support was slightly better than the group without context, though the difference was not significant. The main finding was that the temporal term "kara" (AFTER) evoked the most correct responses and "maeni" (BEFORE) evoked the fewest in both groups. This suggests that children comprehend sentences more easily when the order of mention matches the order of occurrence, an interpretation that favors a processing account rather than a syntactic or semantic account of children's performance failures.